Mechanical Engineering

EN010301A ENGINEERING MATHEMATICS II

2-2-0 (common to all branches except CS & IT) credits 4

MODULE 1 Vector differential calculus (12 hours)

Scalar and vector fields – gradient-physical meaning- directional derivative-divergence an curl - physical meaning-scalar potential conservative field- identities - simple problems

MODULE 2 Vector integral calculus (12 hours)

Line integral - work done by a force along a path-surface and volume integral-application of Greens theorem, Stokes theorem and Gauss divergence theorem

MODULE 3 Finite differences (12 hours)

Finite difference operators Δ, ∇, E, μ and δ interpolation using Newtons forward and backward formula – problems using Stirlings formula, Lagrange's formula and Newton's divided difference formula

MODULE 4 Difference Calculus (12 hours)

Numerical differentiation using Newtons forward and backward formula – Numerical integration – Newton's – cotes formula – Trapezoidal rule – Simpsons 1/3rd and 3/8th rule – Difference equations – solution of difference equation

MODULE 5 Z Transforms (12 hours)

Definition of Z transforms – transform of polynomial function and trignometric functions – shifting property , convolution property - inverse transformation – solution of 1st and 2nd order difference equations with constant coifficients using Z transforms.

Reference

49. Erwin Kreyszing – Advance Engg. Mathematics – Wiley Eastern Ltd.
50. B.S. Grewal – Higher Engg. Mathematics - Khanna Publishers

51. B.V. Ramana - Higher Engg. Mathematics – McGraw Hill
52. K Venkataraman- Numerical methods in science and Engg - National publishing co
53. S.S Sastry - Introductory methods of Numerical Analysis - PHI
54. T.Veerarajan and T.Ramachandran- Numerical Methods- McGraw Hill
55. Babu Ram – Engg. Mathematics -Pearson.
56. H.C.Taneja Advanced Engg. Mathematics Vol I – I.K.International

EN010 302 Economics and Communication Skills

(Common to all branches)

Teaching scheme

2hours lecture and 2 hours tutorial per week Credits: 4(3+1)

Objectives

. To impart a sound knowledge of the fundamentals of Economics.

Economics

Module I (7 hours)

Reserve Bank of India-functions-credit control-quantitative and qualitative techniques

Commercial banks-functions- Role of Small Industries Development Bank of India and National Bank for Agriculture and Rural Development.

The stock market-functions-problems faced by the stock market in India-mutual funds.

Module II (6 hours)

Multinational corporations in India-impact of MNC's in the Indian economy. Globalisationnecessity- consequences. Privatisation-reasons-disinvestment of public sector undertakings.

The information technology industry in India-future prospects

Module III (6 hours)

Direct and indirect taxes- impact and incidence- merits of direct and indirect taxes-progressive and regressive taxes-canons of taxation-functions of tax system- tax evasion-reasons for tax evasion in India-consequences-steps to control tax evasion.

Deficit financing-role-problems associated with deficit financing.

Module IV (5 hours)

National income-concepts-GNP, NNP, NI, PI and DPI-methods of estimating national incomedifficulties in estimating national income Inflation-demand pull and cost push-effects of inflation-government measures to control inflation

Module V (6 hours)

International trade-case for free trade-case for protectionism Balance of payments-causes of disequilibrium in India's BOP-General Agreement on Tariffs and Trade-effect of TRIPS and TRIMS in the Indian economy-impact of WTO decisions on Indian industry.

Text Books

1. Ruddar Datt, Indian Economy, S.Chand and Company Ltd.
2. K.K.Dewett, Modern Economic Theory, S.Chand and Company Ltd.

References

1. Paul Samuelson, Economics, Tata McGraw Hill
2. Terence Byres, The Indian Economy, Oxford University Press
3. S.K.Ray, The Indian economy, Prentice Hall of India
4. Campbell McConnel, Economics, Tata McGraw Hill

Communication Skills

Objectives

- To improve Language Proficiency of the Engineering students
- To enable them to express themselves fluently and appropriately in social and professional contexts
- To equip them with the components of different forms of writing

MODULE – 1 (15 hours)

INTRODUCTION TO COMMUNICATION

Communication nature and process, Types of communication - Verbal and Non verbal, Communication Flow-Upward, Downward and Horizontal, Importance of communication skills in society, Listening skills, Reading comprehension, Presentation Techniques, Group Discussion, Interview skills, Soft skills

MODULE – II (15 hours)

TECHNICAL COMMUNICATION

Technical writing skills- Vocabulary enhancement-synonyms, Word Formation-suffix, affix, prefix, Business letters, Emails, Job Application, Curriculum Vitae, Report writing- Types of reports

Note: No university examination for communication skills. There will be internal evaluation for 1 credit.

REFERENCES

41. The functional aspects of communication skills, P.Prasad and Rajendra K. Sharma, S.K. Kataria and sons, 2007
42. Communication skills for Engineers and Scientists, Sangeeta Sharma and Binod Mishra, PHI Learning private limited, 2010
43. Professional Communication, Kumkum Bhardwaj, I.K. International (P) House limited, 2008
44. English for technical Communication, Aysha Viswamohan, Tata Mc Graw Publishing company limited, 2008

ME010 303: Fluid Mechanics

(Common with AN010 303 & PE010 303)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of fluid mechanics by providing exposure to diverse real world engineering examples.*
- *To develop understanding about basic laws and equations used for analysis of static and dynamic fluids.*

Module I (15 hours)

Introduction and basic concepts-properties of fluids-density, specific gravity, specific weight, specific volume, capillarity, surface tension, compressibility, bulk modulus, viscosity-Newtonian and non Newtonian fluids.

Fluid statics: pressure-variation of pressure-absolute and guage pressure- Pascal's law, manometers- hydrostatic force on plane and curved surfaces-buoyancy and floatation- stability of submerged and floating bodies-metacentric height.

Module II (12 hours)

Euler's momentum equation-Bernoulli's equation and its limitations-momentum and energy correction factors-applications of Bernoulli's equation-venturimeter, orifice meter, pitot tube, orifices and mouthpieces, notches and weirs-rotameter

Module III (10 hours)

Flow through pipes-laminar and turbulent flow in pipes-critical Reylond's number- Darcy Weisbach equation-hydraulic radius-power transmission through pipes-losses in pipes-pipes in series pipes in parallel-hydraulic gradient line and total energy line-equivalent pipe—moody's diagram-water hammer.

Open channel flow-Chezy's equation-most economical cross section-hydraulic jump.

Module IV (12 hours)

Fluid kinematics-Eulerian and Lagrangian approaches-classification of fluid flow-graphical description of flow pattern-stream lines, path lines, streak lines, stream tubes-velocity and acceleration in fluid flow-continuity equation.

Ideal fluids-rotational and irrotational flow-circulation and vorticity-potential function and stream function, basic flow fields-uniform flow. Source, sink, doublet, vortex, spiral flow, flow past a cylinder with circulation-Magnus effect-Joukowski theorem.

Module V (11 hours)

Boundary layer-boundary layer flow theory- boundary layer over flat plate- boundary layer thickness-displacement, momentum and energy thickness-boundary layer separation-methods of controlling-wake-drag force on a rectangular plate-pressure drag-friction drag-total dragstreamlined body-bluff body, lift and drag force on an aerofoil-characteristics-work done.

Hagen-Poiseuille equation.

Text Books

15. Yunus A. Cengel and John M. Cimbala, *Fluid Mechanics*, Tata McGraw Hill, New Delhi
16. R.K.Rajput, *Fluid Mechanics*, S Chand and Company, New Delhi

Reference Books

15. Douglas, *Fluid Mechanics*, Pearson Education, New Delhi
16. Shames I.H, *Fluid Mechanics*, Tata McGraw Hill, New Delhi
17. D. S .Kumar , *Fluid Mechanics*, S. K. Kataria & Sons, New Delhi
18. White F.M, *Fluid Mechanics*, Tata McGraw Hill, New Delhi
19. S. K. Som & G Biswas, *Fluid Mechanics*, Tata McGraw Hill, New Delhi
20. R. K. Bhansal, *Fluid Mechanics& Hydraulic Machines*, Laxmi Publications, New Delhi
21. B.S Massey, *Fluid Mechanics*, Tata McGraw Hill, New Delhi
22. Mody & Seth, *Fluid Mechanics& Hydraulic Machines*, Laxmi Publications, New Delhi
23. F.M. Streeter, *Fluid Mechanics*, Tata McGraw Hill, New Delhi
24. Jagdishlal , *Fluid Mechanics & Hydraulics*, Metropolitan Book Co., New Delhi

ME010 304: Metallurgy and Material Science

(Common with PE010 304 and AU010 304)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide physical concepts of atomic radius, atomic structure, chemical bonds, crystal structure, grain size, work hardening,, heat treatment etc. of metals with mechanical behaviour.*
- *To understand the causes of metal failure and deformation*
- *To determine properties of unknown materials and develop an awareness to apply this knowledge in material design.*

Module 1 (12 hours)

Atomic structure:- Correlation of atomic radius to strength, electron configurations (basic only) -

Primary bonds:- Covalent and Ionic bond: bond energy with strength, cohesive force, density, directional and non-directional

bonding; Metallic bond: conductivity, ductility, opaque, lustrous, density, non directional bonding – **Specific properties of bonding:-** Deeper energy well bond and shallow energy well bond, melting temperature, modulus of elasticity, coefficient of thermal expansion and attributes of modulus of elasticity in metal cutting process - **Secondary bonds:-** classification, hydrogen bond, specific heat etc. **Crystallography:-** Crystal, space lattice, unit cell - BCC, FCC, HCP structures - short and long range order - Effects of crystalline and amorphous structure on mechanical properties - Determination of atomic packing factor of SC, BCC, FCC, coordination number; densities - Polymorphism and allotropy - **Miller Indices:-** slip system, brittleness of BCC, HCP and ductility of FCC - **Modes of plastic deformation:-** Slip, twinning, Schmid's law, correlation of slip system with slip in metals

Module 2 (12 hours)

Classification of crystal imperfections: - types of **dislocation**, source of dislocation, cross slip, climb, jog, kink, forest of dislocation, role of surface defects on crack initiation - Burgers vector - Correlation of dislocation density with strength and nano concept - Significance of **Frank and Read source** in metals deformation - **Mechanism of crystallization:** Homogeneous and heterogeneous nuclei formation, under cooling, dendritic growth, grain boundary irregularity - Effects of grain size, grain size distribution, grain shape, grain orientation on dislocation/strength and creep resistance - Hall - Petch equation; significance high and low angle grain boundaries on dislocation - – polishing and etching to determine the microstructure - crystal structure determination by **X - ray diffraction** method - ***Diffusion*** in solids, fick's laws, mechanisms, applications of diffusion in mechanical engineering.

Module 3 (12 hours)

Phase diagrams: - Limitations of pure metals and need of alloying - classification of alloys, solid solutions, Hume Rothery's rule - single phase, multi-phase equilibrium diagrams - lever rule and Gibb's phase rule - Coring - Equilibrium diagrams reactions:- monotectic, eutectic,

eutectoid, peritectic, peritectoid - Detailed discussion on **Iron-Carbon equilibrium diagram** with **microstructure** and properties changes in austenite, ledeburite, ferrite, cementite, interlamellar spacing of pearlite to strength etc, special features of martensite transformation, bainite, spheroidite etc..

Heat treatment:- Definition and necessity - TTT diagrams - critical cooling rate (CCT) - annealing, normalizing, hardening, spheroidizing - Tempering:- austermpering, martempering and ausforming - Hardenability, Jominy end quench test, applications – hardness and microhardness tests - **surface hardening methods**:- carburizing processes; Nitriding; Flame, induction, laser and electron beam hardening processes; applications - **Types of Strengthening mechanisms:-** grain size reduction, work hardening, Solid solution hardening, precipitation strengthening and over ageing, dispersion hardening - **Cold working**: Detailed discussion on strain hardening; recovery; re-crystallization, effect of stored energy; re-crystallization temperature, effect of grain size; driving force for grain growth - **hot working -** Bauschiner effect and attributes in metal forming.

Module 4 (12 hours)

Alloy steels:- Effects of alloying elements on: dislocation movement, polymorphic transformation temperature, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties – Nickel steels, Chromium steels etc. - Enhancement of **steel properties** by **adding alloying elements:-** Molybdenum, Nickel, Chromium, Vanadium, Tungsten, Cobalt, Silicon, Copper and Lead – **High speed steels:-** Mo and W types, effect of different alloying elements in HSS - **Cast irons**: Classifications, grey, white, malleable and spheroidal graphite cast iron, composition, microstructure, properties and applications – Principal **Non ferrous Alloys: -** Aluminum, Copper, Magnesium, Nickel, Titanium, study of composition, microstructure, properties, applications, reference shall be made to the phase diagrams whenever necessary.

Module 5 (12 hours)

Fracture: – Brittle and ductile fracture - Griffith theory of brittle fracture - stress concentration, stress raiser – Effect of plastic deformation on crack propagation – transgranular, intergranular fracture - Effect of impact loading on ductile material and its application in forging etc.- **Fatigue**:- Stress cycles – Primary and secondary stress raisers - Characteristics of fatigue failure, S-N curve - Factors affecting fatigue strength: stress concentration, size effect, surface roughness, change in surface properties, surface residual stress -Ways to improve fatigue life – effect of temperature on fatigue, thermal fatigue and its applications in metal cutting – Mechanism of fatigue failure – structural features of fatigue:- crack initiation, growth, propagation – fatigue tests - Fracture toughness (definition only) - Ductile to brittle transition temperature **(DBTT)** in steels - **Creep**:- Creep curves – creep tests- Structural change:- deformation by slip, sub-grain formation, grain boundary sliding – Mechanism of creep deformation - threshold for creep - prevention against creep- **Super plasticity:** applications.

Text Books

6. Introduction to Physical Metallurgy – Tata McGraw Hill.
7. Callister William. D. – Material Science and Engineering – John Wiley.
8. Dieter George E. – Mechanical Metallurgy – McGraw Hill.
9. Higgins R.A. – Engineering Metallurgy part - I – ELBS.
10. Raghavan V. - Material Science and Engineering - Prentice Hall.
6. Van Vlack – Elements of Material Science - Addison Wesley.

Reference Books

6. Anderson J.C. *et.al.* – Material Science for Engineers – Chapman and Hall.
7. Clark and Varney - Physical metallurgy for Engineers – Van Nostrand.
8. Manas Chanda - Science to Engineering Materials - Vol I, II and III - Macmillan India.
9. Reed Hill E. Robert – Physical Metallurgy Principles – East West Press.
10. Richards C.W. – Engineering Material Science.

ME010 305: Programming in C

(Common with PE010 305 and AU010 305)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

. To impart advanced knowledge in programming in C language

Module I (15 hours)

Introduction to computer programming; Various I/O functions; Data types; Constants and Variables; Escape Sequences; Type Casting; Preprocessor Directive; Storage Classes; Scope of Variables; Mathematical Operators; Relational Operators; Branching Instructions; Logical Operators; Conditional Operator; Precedence of Operators; Loops – for, while and do-while, break and continue instructions, Nested Loops; Switch statement; Evaluation of e^x, sin(x), cos(x) Numerical Integration using Trapezoidal and Simpson's rules.

Module II (10 hours)

Arrays; One Dimensional Arrays; Selection Sorting; Binary Searching; Various String Handling Functions; Multidimensional Arrays; Matrix Operations (Addition, Transpose and Multiplication); Sorting of Strings; Structure and Union; Array of Structures;

Module III (10 hours)

Functions; Call by Value Method; Stack; Passing One Dimensional and Multidimensional Arrays to a Function; Recursion; Writing Different String Handling Functions Using Simple Functions and Functions with Recursive Calls; Quick Sorting; Macros; Writing Macros for Simple Operations;

Module IV (15 hours)

Declaration of Pointers; Call by Reference Method; Pointer to a Structure; Pointer to an Array; Array of Pointers; Pointer to a Pointer; Self Referential Structure; Dynamic Memory Allocation; Reallocation of Memory; Linear Linked List; Circular Linked List; Double Linked List; Addition, Insertion and Deletion of Nodes from a Linked List; Command Line Arguments

Module V (10 hours)

Different types of Files; Reading, Writing, Appending and Rewriting of Text and Binary Files; Transfer of Data in Blocks; Moving of File Pointer in a File; Usage of bitwise AND, OR, NOT, XOR, Shift Left and Shift Right Operations

Text Books

17. Bryon S.Gottfried, *Programming with C Language.*

Reference Books

25. Balaguruswamy, *Programming in ANSI C,*
26. Deitel, *How to Program C*
27. Kamthane, *Programming with ANSI and Turbo C*

ME010 306(CE) Strength of Materials & Structural Engineering

(Common with PE010 306(CE), AU010 306(CE) and PO010 306(CE))

Teaching Scheme:-

3 hours lecture and 1 hour tutorial per week **Credits**: 4

Objectives

- *To study internal effects produced and deformations of bodies caused by externally applied forces.*
- *To understand the stresses and strains in different materials and analyse strength characteristic of structural members.*

Module I (15 hours)

Introduction to analysis of deformable bodies:-

stresses due to normal, shear and bearing loads-Axial and shear strains – Simple stresses and strains: Material behavior - uniaxial tension test - stress-strain diagrams.

Hooke's law for linearly elastic isotropic material.

Elastic constants - relation between them - Bars of varying cross section -Composite sections- Equilibrium and compatibility conditions- Temperature stresses

Module II (10 hours)

Bending moment and shear force: Cantilever, simply supported and overhanging beams concentrated and U.D loading(analytical method) Relation between load shear force and bending moment.

Module III (15 hours)

Stresses in beams: Pure bending - flexure formula for beams - assumptions and limitations section modulus - flexural rigidity - economic sections beams of uniform strength. Shearing stress formula for beams - assumptions and limitations. Deflection of beams: Moment-curvature relation - assumptions and limitations singularity functions - Macaulays method - moment area method for simple cases.

Module IV (10 hours)

Torsion: Torsion theory of elastic circular bars – solid and hollow shaft assumptions and limitations - polar modulustorsional rigidity - economic cross-sections.

Pressure vessels: Thin and thick cylinders-Lame's equation-stresses in thick cylinders due to internal pressure – compound pipes.

Module V (10 hours)

Combined stresses: Principal stresses and planes-Mohr's circle representation of stress in 2D problems. Use of strain gage rosettes. Combined axial, flexural and torsional loads. Theory of columns: Buckling theory -Euler's formula for long columns - assumptions and limitations - effect of end conditions - slenderness ratio - Rankine's formula for intermediate columns Eccentric loading of columns - kern of a section (rectangular and circular section).

Text Books

18. Timoshenko.S.P, Strength of Materials, Part 1,D.Van Nostrand company, Inc.Newyork.
19. Bansal R.K., Strength of Materials, Lakshmi Publications, New Delhi.
20. Mott, Robert L, Applied strength of materials, 5th Edn, Prentice Hall of India.
21. Popov E.P., Engineering Mechanics of solids, Prentice Hall of India, New Delhi..

Reference Books

7. Nash.W.A , Strength of Materials, Schaum's Outlines,$th Edn, TMH
8. Gere, James M , Mechanics of Materials, Cengage Learning.

9. Shames IH , Pitarresi, James.M, Introduction to Solid Mechanics, Prentice Hall of India.

ME010 307: Computer Programming Lab

(Common with PE010 408 and AU010 307)

Teaching Scheme:-

3 hours lecture and 1 hour tutorial per week **Credits**: 4

Objectives

- *To provide experience in programming with C language*
- *To familiarize with operating systems. file directories, editors, compilers and file managers etc.*
- *To obtain exposure to computer programming languages for technical computation like MatLab*
- *Programming experiments in C to cover control structures functions, arrays, structures, pointers and files*

xiii. Counting characters, lines and words
xiv. Checking leap year
xv. Finding sum of digits and reversing a number
xvi. Generating Prime numbers, Fibonacci numbers and Angstrom numbers
xvii. Sine and Cosine series generation
xviii Implementation of Numerical Integration using Simpson's and Trapezoidal rules
xix. Sorting of numbers, strings and records
xx. Matrix addition and multiplication
xxi. Implementation of dynamic memory allocation
xxii. Implementation of linked lists
xxiii Problems related to files
xxiv Problems related to command line arguments

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
30% - Viva voce

ME010 308: Fluid Mechanics Lab

(Common with AN010 308 , PE010 308 and AU010 308)

Teaching scheme **Credits:** 2

3 hours practical per week

Objectives

. To provide exposure to the actual flow process and various instruments adopted for flow measurement .

- Study and acquire a thorough knowledge of the various pipe fittings and plumbing tools.
- Study the use of different types of taps, valves.
- Study the various measuring instruments like gauges, pitot tube, watermeters and current meters.
- Determination of metacentric height and radius of gyration of floating bodies.
- Determination of hydraulic coefficients of orifices and mouthpieces under constant head method and time of emptying method.
- Calibration of discharge measuring equipments in closed conduits like venturimeter, orificemeter, watermeter etc.
- Calibration of discharge measuring equipments in open channel flow like rectangular and triangular notches.
- Determination of Darcy's constant and Chezy's constant for pipe flow.
- Determination of critical velocity in pipe flow.
- Determination of minor losses in pipe flow.
- Experimental verification of Bernoulli's theorem.
- Determination of Chezy's constant and Manning's number for open channel flow.
- Calibration of Plug –Sluices.

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record

30%- Test/s

20%- Regularity in the class

End Semester Examination *(Maximum Marks-100)*

70%- Procedure, conducting experiment, results, tabulation, and inference

30% - Viva voce